DOCUMENT RESUME

ED 025 218 24 HE 000 312

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An Economic Analysis of College Scholarship Policy.

Johns Hopkins Univ., Baltimore, Md. Center for the Study of Social Organization of Schools.
Spons Agency- Office of Education (DHEW), Washington, D.C. Bureau of Research.
Report No- R-24
Bureau No- BR-6-1610-24
Pub Date Aug 68
Grant- OEG-2-7-061610-0207
Note- 40p.
EDRS Price MF-$0.25 HC-$2.10
Descriptors- Cost Effectiveness, *Educational Finance, Equalization Aid, *Higher Education, Resource Allocations, *Scholarship Funds, Student Costs, *Student Loan Programs, *Tuition Grants

A national scholarship policy based on a cost-benefit analysis of the social value of education is proposed as one method for improving current patterns of allocating US college scholarships and tuition funds. A central college subsidy agency, operating on a limited budget, would be required to allocate funds according to the maximum overall social contributions of the students. Emphasis would be placed on present benefits to society rather than the student's future economic contributions. This policy would reduce present stress on intellectual ability as an important criterion for student subsidy, and include criteria such as family financial status, type of career best suited to student, and overall intellectual ability. The total cost of subsidizing a student would be covered by the funds paid directly to him as well as to the college where he is trained; colleges would be induced to provide their services at cost. Other considerations in awarding a scholarship would be the appropriateness of the selected college for the student's particular abilities and the amount of money he can contribute toward his education. The college would be selected by the student within limits set by the agency. This system would increase the current subsidy level and encourage an expansion of quality college education to include larger segments of the population. (WM)

PA24
BR-6-1610-24

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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THE JOHNS HOPKINS UNIVERSITY

REPORT No. 24

THE CENTER FOR THE STUDY OF SOCIAL ORGANIZATION OF SCHOOLS

AN ECONOMIC ANALYSIS OF COLLEGE SCHOLARSHIP POLICY

HE 000 312

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AUGUST, 1968

Acknowledgments

I want to thank E. S. Mills and Jurg Niehans of the Department of Political Economy, The Johns Hopkins University, for their helpful comments. Allan Sorkin was a diligent and helpful research assistant. Work on the paper was financed in part by the Center for the Study of the Social Organization of Schools of The Johns Hopkins University and in part by the College Scholarship Association.

Introduction

This paper presents a framework for a national college scholarship policy. Decision-rules are developed which are designed to enable the policy maker to use with maximum effectiveness a limited budget for college student subsidy.

The question of a national scholarship policy is obviously an important one. In 1967, some six million students attended college in the United States.[1] The total cost of training them in that year was probably between $30 and $60 billion. The selection of these students for college and their distribution among high- and low-quality institutions was heavily influenced by the distribution of college and student subsidies. In the year 1963-1964, for example, tuition accounted for only one-fifth of the colleges' total expenditures from current funds.[2]

At the present time, the pattern of allocation of these scholarships and tuition subsidies resembles that of a patchwork quilt. Individual colleges may maximize the prestige of their college, or what they conceive of as the national interest, or pursue some other goal. Yet there are several reasons for believing that decisionmakers in the American college system may be more receptive to a consideration of the over-all effects of their financial aid and admissions policies than this "patchwork quilt" pattern would suggest. The proportion of the college system under some sort of public control is large and is growing; two-thirds of all college students now attend state or city colleges.[3] Moreover, the influence of national foundations and of the federal government has grown to the point where they are in a position to effect meaningful changes in this allocation of national educational resources.[4]

Third, the members of the College Scholarship Association, representing over 700 of the nation's higher-quality colleges, have in fact agreed

upon a number of common scholarship policies,[5] one of the most important of which is an agreement to base the financial contribution required from a student on his family's economic position, rather than on his own ability. While this agreement may be described by the cynic as a cartel-like arrangement to prevent the truly able student from extracting a "student surplus" from the college system, the compact still represents an important step towards systemwide thinking and a striking example of collective action by the private colleges in furthering their common goals.

Finally, one must give some weight to the often-expressed wishes of college administrators for guidance as to how their own college financial aid and admissions policies might be better designed to fit into some acknowledged system of social goals and priorities.[6] This positive attitude, together with the changes in the structure of the system of higher education, leads one to hope that further attempts toward common scholarship policies will be forthcoming.

But if many economists and educators agree that a common scholarship policy might be a good idea, it is not unfair to say that there is considerable uncertainty as to the appropriate method of allocating funds. Perhaps the simplest, least ambiguous, and most comprehensive proposal for a national scholarship policy was made by the government economist Roy E. Moor, in the United States Department of Health, Education, and Welfare's publication <u>The Economics of Higher Education</u>:[7]

> How is the allocation of funds to be made among those who meet the criteria both of need and of ability? If we adhere strictly to the economic justification for Federal aid, then the problem can be solved by starting with the student of greatest intellectual potential, giving him the minimum number of dollars that will be just sufficient--when added to his own financial resources--to pay for his education, continuing the procedure with the second most able student, and so on until the Federal allocation to education has been exhausted. This satisfies the requirement for getting the greatest potential

> return from the Federal educational investment, in the same way that a businessman selects new capital equipment on the basis of greatest potential returns, while trying to pay the lowest price for each piece of equipment.

Moor's decision-rule will be challenged in this paper on three grounds: that intellectual ability cannot always be used to obtain a measure of the value of educating a potential student; that as long as federal and other subsidies are limited, the financial status of potential college students must be considered not only in deciding the amount of their scholarships but also in selecting students for scholarship awards; and that quality of the college, as represented by dollars invested per student, must be considered along with the admissions decision.

It is argued here that the ability criterion must be rejected for two reasons: first, that the ability of a high school graduate is not the only measure of the contribution to society that he would make if he went on to college; and second, that it is the present value to society of an investment in the education of a youth, rather than the contribution he makes after graduation from college, that is the relevant criterion for subsidy. The first point is obvious: the social benefits contributed by a college student may depend upon such factors as sex, race, class, region, and future occupation, as well as upon intellectual ability.[8] The weight to be given to each of these characteristics cannot easily be determined by economic analysis. Hence, in the present model, the determination of the marginal social benefit of different groups of students is left to the policymaker.

But even if the social benefits provided by college graduates were perfectly correlated with their measured intellectual ability upon graduation from high school, it would not be optimal to allocate scholarship funds on the basis of ability. A rational student subsidy decision requires that the discounted value of the improvement in a youth's social product as a result

of his education be compared with the cost to society of training him. This calculation of the present social value of a youth's college education may well yield a different ranking of scholarship applicants than would a comparison of the social benefits these applicants would provide as college graduates.

One would expect that as one moves from lower towards higher levels of marginal social benefits of college graduates there will be cases in which parallel upward movements in the marginal social benefits that an individual could contribute with a high school diploma would be so great that the social return from investing in his college education will diminish. For example, one youth might be slightly more intelligent than another, but be blessed with far more manual dexterity. Here, the return to society for educating the more intelligent youth might well be less than for his less bright fellow. Hence, in this paper present social value, rather than marginal social benefits, is suggested as the correct criterion for educational subsidies.

Moor's decision-rule must also be challenged on the grounds that he does not use financial status as a criterion for selecting students for scholarship awards. Moor proposes that the scholarship recipient be offered that sum which will just induce him to go to college. A similar proposal is made in the present paper. However, Moor further proposes that the scholarship recipient be selected in accordance with his intellectual ability, without reference to his financial need. This neglect of the financial cost to the system of a scholarship is a luxury that cannot be afforded when subisdy funds are limited. It can be shown that Moor's criteria for selecting students for his subsidy program will not lead to optimal results[9] -- at least not if the allocation of subsidy takes place subject to a budget constraint.

The national policymaker's problem is analogous to that faced by college admissions and financial aid officers, who are given a fixed sum to spend for student aid and told to come up with a freshman class which is likely to stay the course. If funds are limited, the administrators will consider the scholarship required to obtain a student as the student's "price," and will then compare this price with the expected benefit that he will bring to the school. Thus, the administrators will tend to prefer, ceteris paribus, students who require partial scholarships over those who require full support.[10]

It is also shown here that the financial resources of a student will cease to be a determinant of the total investment in his education if the college subsidy fund is sufficiently large and if the private benefits of his education do not exceed its social benefits.

Finally, Moor neglects altogether the problem of investment on the intensive margin--the choice of college quality for the scholarship recipient. This is an important issue in scholarship policy and is likely to become even more important as the number of bright high school graduates who are unable to afford some form of higher education becomes a minority. It has aroused considerable controversy within the academic-administrative community. To take but one example, the federal government's National Merit Scholarships program permits the recipient to select any suitable college to which he can gain admission. The government will then pay 100 per cent of a needy student's tuition, regardless of its cost. This policy has been widely criticized by low-cost or low-tuition colleges on the grounds that it biases the student's choice in favor of the high-quality, Ivy-league-type schools.

The American Council on Education takes a similar position on these National Merit Scholarships:

> The objectives of a federal scholarship program should be to offer the opportunity of college education to qualified students who would otherwise be denied it for lack of financial resources. Therefore Federal funds should not be used to encourage students financially able to attend an adequate institution merely to seek admission to other institutions at higher cost.[11]

The Council suggests that the federal tuition grant to each federal scholarship winner be the same.[12] This policy would tend to send the poorer youths to the lower-quality colleges.

One of the more important tasks of the present paper is to suggest a scholarship policy that will integrate the choice of college quality into the scholarship or subsidy decision. Both the National Merit Scholarship policy of permitting the student to upgrade the quality of the college he chooses at no additional cost to himself and the position that scholarships should not have uniform tuition allowances are rejected here in favor of a decision-rule that makes the resources allocated to the student's education a function of both the contribution of college quality to his productivity and his financial contribution.

A Model for a Coordinated, Student-Oriented College Subsidy Plan

In the model for college student subsidies presented here, all subsidies will be distributed in accordance with a national scholarship policy.[13] The policy will operate as though an "agency" allocates funds to students, who then, within limits set by the agency, select their colleges. Colleges are induced to provide their services to the students at cost.[14]

This plan is, then, to be oriented to the subsidy requirements of students. But colleges also have their interests,[15] and an argument can be made for diverting some subsidy funds to serve these ends. A student-oriented subsidy program could be used to advance certain special college interests (although perhaps it ought not to be so used). If a large

portion of college subsidy funds come from New York or California, students from those states might be favored. Thus, in our model, the marginal social benefit of the college education of a New Yorker could always be considered to be greater than that of, say, a Texan.

But a student-oriented subsidy plan cannot be warped to serve every interest of the colleges. It cannot be used to ensure that New Yorkers study in colleges located in that state. Moreover, it in no way aids the small, inefficient school which is unable to attract students in a competitive market. If this type of college-oriented goal is regarded as worthy of subsidy, then a separate college subsidy plan could be devised which would enable the favored schools to be aided to offer their services to students at less than cost.

Constraints on Agency Decision-Making

A central college student subsidy agency would, in practice, be required to carry out its policies subject to a number of constraints. These constraints will have important effects on the decision-making of the agency. Hence, before discussing in detail ways in which such an agency might try to achieve its stated objectives, we will begin by defining the constraints on and powers of the agency in the model that will be used here. The constraints of this model -- that funds for student subsidy are limited, and that a number of student rights are respected -- are selected as typical of those under which a national scholarship policy might operate in the United States.

A major restraint is that the agency will have to maximize its objective function subject to a budget constraint: it will have to obtain the maximum social benefit it can with an inadequate subsidy fund or

budget. (The special case where the subsidy is sufficient and does not act as a constraint will also be examined.)

The imposition of a budget constraint suggests another limitation: the agency does not act as a "benevolent monopsonist."[16] It will be barred from adjusting for effects of a change in the distribution of funds among students or among educational resources (or between students and resources) on the wage or price structure.[17] Thus, for the purposes of agency decision-making, the cost of subsidizing a particular student will be the amount paid to him and to the college that trains him. The effects on the supply price of resources and on the opportunity costs of students will not be considered.

This limitation has great empirical significance, since the agency will often find itself confronting very different elasticities of supply for each resource that it employs. For example, in the absence of this limitation the agency might decide to invest less in the training of the most able students if the elasticity of supply of those with the requisite intelligence to teach this group was much lower than the supply elasticity of other teachers.[18] It is not clear that some form of agency monopsony behavior would not further a reasonable social welfare function. After all, such behavior would help to increase a level of investment in college education that is, presumably, sub-optimal. However, in the present model, the agency is forced to act according to competitive rules.

Six additional constraints on the agency are imposed in this model. First, overinvestment in college education, whether by wealthy students or by those with a strong preference for education, is not to be discouraged by national scholarship policy. The agency may not charge the "overinvestors" more than the actual cost of their college education.

Second, the student will receive a check for tuition and a cash stipend. He may then attend the college of his choice.[19] However, he may not use the tuition check for living expenses. This constraint is imposed to permit competition among colleges, while ensuring that the poor student will not elect to underinvest in his college education (using a portion of his tuition subsidy to support his family).

Third, if the agency decides that a student is worth a subsidy of X dollars but believes that his financial situation shows that he will require a somewhat larger subsidy, the agency will still offer him the scholarship of X dollars. In this limited sense, no student will be rejected for subsidy outright on the basis of his poverty. He will also be allowed to vary the quality of school he attends and the tuition that he pays without invalidation of his subsidy. However, this subsidy will then be changed according to a schedule chosen by the agency. This constraint is discussed more fully in the section "Problems of Preference Measurement" on pp. 15-18 below. It is shown there that these flexible policies are actually consistent with agency maximizing behavior by the agency.

Fourth, a student may always refuse his subsidy altogether and still attend a college of whatever quality he chooses. He will then be charged no more than the actual cost of his education. This constraint will prevent the agency from offering the "underinvestor" an all-or-nothing bargain whereby he must choose between a college of the agency's choice and no college at all.

Fifth, students will pick a course of study after their subsidy has been agreed upon. The agency will be able to guess at the probable course of study of a particular student on the basis of objective evidence, but it will not be able to direct the student's work by means of its subsidies.

Like number six below, this constraint might be modified in practice: a given individual might be more heavily subsidized than otherwise if he agreed to a course of study which would increase his contribution to society after graduation without proportionately improving his earnings (the study of political theory -- which might make him a better citizen -- would be a good example).

Sixth, students will not be required to repay part or all of their subsidies in the years following graduation. This constraint is introduced in order to simplify the analysis, but it is likely that, in practice, it would be relaxed. If, as one would expect, many students have a higher rate of time preference than the "social rate" held by the agency, then it probably would be efficient to require some repayment from the student. In this way, the agency could, in the long run, support the maximum investment in college with a given level of subsidy.[20]

Such provisions for partial or total repayment of subsidies should, however, be sharply distinguished from an alternative model in which all college subsidy funds are used to underwrite a loan program. Such a loan program would not attack the problems raised by differences between the social and private costs and benefits of college education for various groups of students. The resolution of such problems has been one of the traditional justifications of student aid programs. A provision for this resolution would probably be retained in applying the present model.

The Use of Cost-Benefit Analysis in Allocating College Student Subsidy Funds

Within these various constraints, the policymakers may maximize their objective function (i.e., what they consider to be the maximum net social benefit) by means of techniques made familiar by cost-benefit analysis.[21] The agency must make decisions on three margins: whom to admit into college

from the group that would not attend in the absence of subsidy; how much to spend on the education of those admitted; and by how much to subsidize students who would attend less-than-optimal-quality colleges in the absense of subsidy. In the first case, the increase in the agency's objective function per dollar of subsidy will be equal to the ratio of the social value of the ith student's education to the student's subsidy.

The implications of this rule can be seen more clearly with the introduction of a simplified model of the marginal social value of the college education of the ith student. Let

$$(1) \quad V_i = \frac{Y_i - X_i}{r} - 4(X_i + K_i) ,$$

where Y_i is the marginal social benefit per year of the ith individual if her graduates form college, X_i is his annual marginal social benefit if he does not, K_i is the expenditure of educational resources on him during each of the years he attends college, and r is the rate of social time preference.[22] Then the increase in the agency's objective function per dollar of subsidy will be equal to:

$$(2) \quad \frac{V_i}{S_i} = \frac{\frac{Y_i - X_i}{r} - 4(X_i + K_i)}{S_i} ,$$

where S_i is the subsidy given to the ith student.[23]

In the second and third cases, the contribution of a dollar of subsidy to the agency's objective function will be equal to the ratio of the increase in the social benefit of the student's college education per additional dollar expended on his education to the increase in the subsidy required per additional dollar expended on his education. Using equation (1), we may write:[24]

$$(3)\quad dV_i/dS_i = \frac{dV_i/dK_i}{dS_i/dK_i} = \frac{\frac{Y_{iK}}{r} - 4}{dS_i/dK_i} .$$

if the social value per dollar of subsidy of the college education of the ith student is written R_i $\left[\text{i.e., } R_i = V_i/S_i\right]$ and the student's financial contribution to his education is written C_i $\left[\text{i.e., } C_i = 4(X_i+K_i) - S_i\right]$, then equations (2) and (3) may be rewritten:

$$(4)\quad R = \frac{\frac{Y_i - X_i}{r} - 4(X_i+K_i)}{4(X_i+K_i) - C_i}$$

and

$$(5)\quad \frac{dV_i}{dS_i} = \frac{dV_i/dK_i}{dS_i/dK_i} = \frac{\frac{Y_{iK}}{r} - 4}{4-dC_i/dK_i} .$$

In order for the agency's objective function to be maximized (i.e., in order that the maximum net social benefit will be produced), an additional dollar of subsidy spent for one purpose must make the same contribution to the agency's objective function as a dollar spent for any purpose. Let this contribution of the marginal subsidy dollar be called λ. Then, for all subsidized students, in equilibrium, $dV_i/dS_i \geq \lambda$. Moreover, in equilibrium, the value of R_i for the marginal student admitted into the program, $R_m = \lambda$. This evaluative function R_i will be greater than the cutoff value λ for all other students admitted and will be less than λ for all students rejected from the program.

A further clarification of the agency's decision-making is possible if we combine its function for evaluating the present social value of college education with a model of individual or private college choice. This will permit some understanding of the required subsidy per student.

If the student regards his college education as an investment,[25] he will compare the discounted returns (financial and nonfinancial)[26] of a college education with its costs.[27] If the student is able to vary his direct expenditures for college (tuition, fees, books, and the like), he will select a level of expenditure, and hence of college quality, that maximizes the present value of college education for him. He will then compare the present value of this optimal college education with the present value of going to work. This decision of the high school graduate may be analyzed in terms of a simplified[28] model of individual college choice that may easily be compared with that used in this paper for measuring the social value of college: let the private value of college to the ith individual equal

$$(6)\quad \hat{V}_i = \frac{Y_i - X_i + Z_i}{\hat{r}_i} - 4(X_i + K_i + W_i) \quad ,$$

where $\hat{r}_i$ is the ith student's rate of time preference, X_i is the difference between the private and the social benefits received by the graduate as a result of his college education, and W_i is the difference between the annual private and social costs of going to college. Thus $Y_i - X_i + Z_i$ is the annual stream of private benefits from a college education (the sum of private financial and nonfinancial benefits) and $X_i + K_i + W_i$ is the annual private cost of a college education (the sum of direct and opportunity costs).

In the unsubsidized case (where the individual is paying the full cost of his training), the student will find an optimal level of college quality when

$$(7)\quad \hat{V}_{iK} = \frac{Y_{iK} + Z_{iK}}{r_i} - 4(1 + W_{iK}) = 0 \; .$$

The student will then go to college if, at this optimal K, $\hat{V}_i > 0$.

This model of student choice has an immediate application to the scholarship policy problem. Some high school graduates will find the private value of college greater than zero ($\hat{V}_i > 0$) and hence will need no subsidy as an inducement. For some others, the social value of college education will be negative ($V_i < 0$), and of course they would not be subsidized. A college education for members of a third group will be socially desirable, but these individuals will be unable or unwilling to pay for it ($V_i > 0$, $\hat{V}_i < 0$); members of this group will be eligible for subsidy.[29]

The minimum subsidy required to induce this group of high school graduates to attend college will be equal to the loss they incur (in their own estimation) by so doing. The agency could then obtain the most investment per dollar of its subsidy by setting $S_i = -\hat{V}_i$[30] for these students. Any subsidy less than this would not induce these high school graduates to go on to college; a greater subsidy would create a surplus or bonanza for the student, with no additional gain to the agency.

A similar argument shows that the minimum increase (and, hence, the optimum increase) in subsidy required to induce a student to increase his total investment in education will be equal to the net private loss he would incur if he were to increase this investment without subsidy;[31] i.e., that

$$(8) \quad dS_i/dK_i = \frac{-d\hat{V}_i}{dK_i} = 4(1 + W_{iK}) - \frac{(Y_{iK} + Z_{iK})}{\hat{r}_i} .$$

A special problem arises in the case of the "underinvestors," those who would go to a lower-quality school if they were not subsidized. In this model (see constraint 4 above) the underinvestors continue to have the option of attending the lower-quality school of their choices and

paying the full cost. Since this option presumably has some positive value to them, the agency must pay them more to attend a college of its choice than would be necessary if they could be confined to a choice between this college and none at all. If the private value of investment in the college chosen without subsidy is $\hat{V}_i$, then the minimum subsidy to be paid to students in this group is equal to the private value of the loss they incur by going to the higher-quality school, $V_i' - V_i^*$.[32]

Problems of Preference Measurement

The effectiveness with which the agency can use this cost-benefit analysis to maximize its objective function will be limited by the precision with which it can measure its own preferences and those of the students. The agency must first be aware of its own preferences, at least to the extent that it can measure the social benefits and costs of educating potential college students.[33]

Moreover, it must understand student preferences to the extent that it can predict the amount of subsidy necessary to induce a high school graduate to go to a college of a particular quality. It must also be able to determine the subsidy required to induce the "underinvestor" to move from the low-quality college of his choice to a high-quality school of the agency's choice. These preferences will not be easy to discover; the individual student will have considerable incentive to conceal his preferences, nor will bargaining with him be likely to lead to his open expression of them.[34]

A more productive approach to the problem of determining the student's preferences would be a further extension and refinement of the means and ability tests now used by colleges for scholarship applicants. These tests would be used to find subgroups of high school graduates which were

homogeneous not only in the present social value of their college education (V_i) but also in the amount of subsidy required to induce them to go to college, and hence (since $S_i = -\hat{V}_i$) in the net private value of this education. If the total population of high school graduates were broken down into a large number of smaller groups, stratified by financial resources, intellectual ability, opportunity costs, and the like, trial-and-error methods could be used to ascertain the value a typical student of a given group would place on a college education.[35]

But however clever the agency may be in ascertaining student preferences, its price discrimination will be imperfect, and the choice of students will be, at best, only approximate. This approximation might be improved by utilizing agency constraint number three above, which permits students to make contributions other than those predicted by the agency. Equations (4) and (5) suggest a method by which the agency can use this flexibility to further its policy aims. These aims can only be furthered if it offers scholarships to students whom the agency judges to be unable or unwilling to make the requisite financial contribution, but who will in fact be motivated to do so when offered the scholarship (i.e., who will be willing to make a contribution)

$$(9) \quad C_i \geq 4(X_i+K_i) - \frac{V_i}{\lambda}$$

so that R_i will always be greater than or equal to λ. Similarly, this constraint provides that any student in the program who wishes to pay more or less to vary the quality of his education might do so along the schedule.

$$(10) \quad \frac{dC_i}{dK_i} \geq 1 - \frac{1}{\lambda}\left(\frac{Y_{iK}}{r} - 4\right),$$

so that the increment in present social value per additional dollar of subsidy (dV_i/dS_i) will always be greater than or equal to λ. The agency would lose nothing by making such offers, and it might retain in the program students who otherwise either would not go to college or would underinvest in their education.

But the use of the third constraint may still leave the policymakers with suboptimal results if, within many (or all) of the groups accepted into the subsidy program there are some students who would attend college with a lower subsidy than the one they receive and other students who do not attend college at the subsidy level set by the agency, but who would accept a somewhat higher subsidy. The loss of this second group to the college system would be serious if it took place within groups for which V_i/S_i was much greater than λ (i.e., among students for whom the present social value of their education per dollar of subsidy was much higher than the cutoff ratio for the marginal student accepted into the subsidy program).

If the agency, perhaps through subsampling, could make some estimate of the responsiveness of group members to an increase in subsidy,[36] it could come closer to an optimal solution.

A plausible solution could then be obtained by raising S_i to equal V_i/λ for each group (unless a lower subsidy level, S_i, resulted in 100 per cent attendance). If this rule is followed, then in each group the marginal student who accepts a subsidy will contribute the same social benefit per dollar of his subsidy.

But this rule would not in fact be optimal, since it does not include as a marginal subsidy cost the increase in the average subsidy paid to each student in the group that occurs when the subsidy level is raised to attract an additional student. As a result of this increase in average

subsidy, if this rule is applied, the intramarginal gain to the agency of those groups for which R_i was greater than λ under the original rules would be eliminated, if the marginal student's subsidy $S_i = V_i/\lambda$, (or reduced, if all the students in the group accept the subsidy).

But if these effects of the agency's marginal decisions on the group subsidy are taken into account, then a maximizing rule that will meet this objection can be found: a maximum social gain will be obtained from the college education of this group by setting

$$(11) \quad S_i = \frac{V_i}{(1+E_{si,N})} \quad (N \leq M),$$ [37]

where $E_{Si,N}$ is the percentage increase in subsidy per student required to produce a 1 per cent increase in the number of students in the group who will accept the subsidy, and M is the total number of high school graduates in the group.[38]

The substitution of this rule for the original decision-rule (the rule which was based on an estimate of the "typical" student's behavior) would increase the proportion of students going to college in those cases where $R_i > \lambda(1+E_{Si,N})$ and reduce it in those cases where $R_i < \lambda(1+E_{Si,N})$.[39]

The importance of this problem for policy purposes depends upon the size of $E_{Si,N}$. If this elasticity can be reduced to a very low level by suitable stratification methods, then the simpler rule of setting $V_i/S_i = \lambda$ for a "typical" student may be employed without any serious loss.

The Problem of Interdependence

Marginal rules for the agency's social optimum can be developed, then, such that, when they are followed, the policymaker's social welfare function cannot be improved by any transfer of funds, at least in the

immediate neighborhood of this optimum. However, this social decision-rule for investment in college education is considerably more complicated in its application than are the rules individuals use to determine their investment in college. A social optimum requires that the marginal conditions be satisfied for all students simultaneously. But the marginal social value of any one student's going to college, or the marginal social value of an additional dollar expended on the education of a subsidized student, will be dependent on the subsidies given to all the other successful applicants.

In the calculation of $V_i = \frac{Y_i - X_i}{r} - 4(X_i + K_i)$ the elements Y_i, X_i, and K_i of V_i will each be functions of the college education (or lack of it) of all other high school graduates. Thus Y_i, the social benefits of the ith student's college education, will be affected both by the total quantity of college education and, more directly, by the education received by college students of similar abilities, aptitudes, and interests.[40] X_i, the social benefits per annum of the ith high school graduate if he does not go to college, will similarly be related to the numbers entering the labor force without college, as well as of the numbers entering it with college.

K_i, the annual expenditure of resources for the training of the ith student, will be a function of the supply price of these resources as well as of their quantity. These supply prices may be affected by the overall level of resources allocated to higher education or by the allocation of this expenditure among the different types of resources purchased.

However, while these interdependencies will make planning more difficult, they will not invalidate the use of the marginal rules as a criterion for an optimum. Further problems will be created by these interdependencies when the agency must maximize its objective function subject to constraints.[41]

One result of recognizing the influence of subsidy decisions on the supply prices of educational resources is, as we have seen, the necessity of incorporating such effects into the model used for selecting students for subsidy. In the present paper, this was done by introducing the anti-monopsony constraint.

Some Characteristics of the Equilibrium Solution

If the decision-rules proposed here are followed, the internal social rate of return for the marginal student admitted into the subsidy program will equal

$$(12)\quad I_i = \frac{r\hat{r}_i}{\hat{r}_i + r\lambda}\left[1 + \lambda\left(1 + F_i - \frac{A_i}{\hat{r}_i}\right)\right],$$

where

$$A_i = \frac{Z_i}{4(X_i+K_i)} \quad \text{and} \quad F_i = \frac{4W_i}{4(X_i+K_i)}\ .$$

The social value of an additional dollar spent on the education of a subsidized student will be computed

$$(13)\quad \frac{Y_{iK}}{4} = \frac{r\hat{r}_i}{\hat{r}_i + r\lambda}\left[1 + \lambda\left(1 + W_{iK} - \frac{Z_{iK}}{4\hat{r}_i}\right)\right].$$

These expressions will have very different values, depending upon the size of subsidy (and hence of λ).

If the subsidy is very small, λ will approach infinity. In this extreme case, where subsidies are so small as to have no noticeable effect on the allocation of teaching resources, equations (12) and (13) converge to

$$(14)\quad I_i = \hat{r}_i \quad (1 + F_i - \frac{A_i}{\hat{r}_i})$$

and

$$(15)\quad \frac{Y_{iK}}{4} = \hat{r}\,(1 + W_{iK} - \frac{Z_{iK}}{4}) \ .$$

In this case, private benefits, discounted at individual time preferences, are compared with private costs. This solution is similar, algebraically, to that represented by the equations of individual choice today (see p. 13 above). However, the solution is different here in that, with zero subsidy, the costs of college are paid for in full by the student, whereas part of these costs are in fact at present underwritten by the colleges and other agencies.

Without subsidy, one would, of course, expect to see some of the shortcomings of the present system displayed in a more intensified form. One would observe, first, a decline in the number of college graduates, as well as in the resources expended per student. This is apt to be accompanied by a decline in the private return to college if the subsidy is deducted from the cost of college in estimating the private rate of return, and an increase in the private rate of return if the subsidy is not deducted. The second effect would probably be a reduction in the proportion of able students among students in college. It is unlikely that the elimination of subsidies would reduce the proportion of able students at high-quality colleges[42] to their level in the population of high school graduates because of the high private monetary rate of return for the able of college education,[43] in conjunction with the large investment in college education by members of this group.[44] However, college student subsidy plans today do generally favor the intellectually able student (both directly, through

scholarship policy,[45] and indirectly, through restrictive admissions at the better, more heavily endowed colleges). The elimination of student subsidies would then be expected to reduce the extent to which intellectual ability determines investment in college education.

Third, one would expect an increase in the proportion of middle- and upper-class students in the college population. In an unsubsidized market [see equations (14) and (15)], the criteria for investment in a student's college education are the internal private rate of return on the investment and the student's rate of time preference. Application of these criteria will show relative (as well as absolute) underinvestment in college education by the poorer students. They tend to discount future returns at a higher rate than others, in part because of budget limitations and imperfections in the capital market. The private financial rate of return will also tend to be lower for the poorer student.[46] The structure of job contacts and information will probably favor the middle-class college graduate somewhat more than it does the middle-class high school graduate.[47] Moreover, the observed correlation between intellectual ability and economic class in the population may be expected to raise the financial return to college for middle-class youths. Finally, the private, non-financial benefits of college may also be given a lower value by the poor, at least if these benefits are superior goods.

These tendencies of the private market to generate economic inequalities in the allocation of college teaching resources are modified today by the system of subsidies to college education. A college will estimate a student's financial needs in considering him for a scholarship.[48] Moreover, tuition levels are typically set below cost, which enables the poor or lower-class student to afford a college education.[49] One would expect,

then, that the elimination of these subsidies would place a disproportionate burden on the poor, and probably would exclude even more of them from college.

Finally, without subsidy there would be an increase in the importance of the strictly private benefits of college in the allocation of educational resources. Subsidies today are allocated on the basis of estimated social benefits, donors' preferences, and the preferences of college administrators. In the absence of these subsidies, expenditures on college would be made only by the students themselves, who would be guided by private benefits alone in deciding how much to invest. There would be important changes in the geographical, religious and occupational distributions of college graduates. One would expect the greatest decline among persons living in areas which now have a highly subsidized public or private system, the least decline among atheists (since they gain least, presumably, from the system of religious colleges), a decline of scientists relative to advertising men, and so forth.[50]

As the subsidy increases to an adequate level, some but not all of these effects are reversed. If the subsidy is sufficiently large for the agency to accomplish its objective, λ, R_m goes to zero and the allocative equations (12) and (13) take the simple form:

$$(16) \quad r_m = r$$

and

$$(17) \quad \frac{Y_{iK}}{4} = r \ .$$

Both the internal social rate of return on the marginal student (with or without funds) and the social return on an additional dollar expended on improving the quality of a student's education are equal here to the social rate of time preference. At this full subsidy equilibrium position, the

numbers going to college and the resources alloted to college teaching are greatly increased. Moreover, neither wealth nor private benefits play any role in assigning students to college (an important exception is found in those students who "overinvest" in their education for consumption purposes). However, wealth and private benefits <u>are</u> used in the calculation of the price of college to be charged the student. His contribution to his education will continue to be equal to the value of the private benefit of college, discounted at his individual rate of time preference. Hence, the wealthier students and those receiving greater private benefits will pay more. Finally, ability is considered to the extent that it contributes to the social return to college.

If existing college teaching subsidy resources were coordinated into a national scholarship policy, most probably the result would be an equilibrium solution between these two extremes: subsidies would be greater than zero but less than the level that policymakers would consider adequate to equate marginal social benefits and costs of training all potential students (i.e., $0 > \lambda < \infty$). In the intermediate solution, the more complicated equations (12) and (13) on pages 20 above are necessary to describe the allocation of college teaching resources.

This intermediate solution, which results from limited subsidy funds, clearly partakes of the characteristics of both the unsubsidized and the fully subsidized solutions. The extent to which it approaches either of these extremes will, of course, depend upon the value of λ, and therefore on the level of subsidy.

For example, in the intermediate case, as in the unsubsidized case, the student's time preference will be a determinant of his rank, and hence of his acceptance into the subsidy program. However, even this partial subsidy will reduce the importance of wealth or time preference in admissions to

college; in the intermediate models, on the margin of acceptance, the increase in the internal social rate of return per increase in the rate of individual time preference is not as great as in the unsubsidized case (mathematically, $\partial I/\partial \hat{r}_i$ is reduced as the subsidy is increased).

Again, students with higher private benefits will also be favored in admissions and quality policy. However, even with limited subsidy budgets, social benefits will now play some role in the allocation of college teaching resources (mathematically, $|\partial I/\partial A|$ is reduced as the subsidy is increased). Moreover, with limited subsidy funds there will be a tendency as in the case of full subsidy, for the wealthiest students and students whose private benefits from education are highest to pay a higher proportion of their educational costs than others.[51]

Thus, the decision-rule presented in this paper provides that as the subsidy is increased, and λ is reduced there will be a gradual easing of discrimination against the needy and a similarly gradual increase in the role that social benefits and costs play relative to private benefits and costs in the allocation of college teaching resources among students. Moreover, if it seems optimal to the policymakers, this decision-rule may provide for a gradual increase in the quality of college education simultaneously with increases in college attendance.

Conclusion: The Effects of a Coordinated Student Subsidy System

This discussion of the formal qualities of the intermediate solution with limited student subsidy funds shows that it shares many of the features of the existing decentralized allocation of college teaching resources. One might ask whether any important changes in the allocation of college teaching resources would in fact take place if a national system of subsidy were substituted for the present arrangements.

The importance of the intellectual ability of students in determination of subsidy allocation would almost certainly be diminished by coordination of scholarship policies. Intellectual ability is today the most important qualification for receipt of a student subsidy. This preference for the intellectually able is the result both of the academic value system of college administrators and of the fact that colleges are usually judged in terms of their end product, rather than in terms of the rate of return on their investment in human and other capital. A national scholarships policy would consider a number of goals, and might be less influenced by the narrow academic views and concern with prestige of the individual college. The resulting changes in the college system's objectives might well reduce the emphasis on intellectual ability as a criterion for student subsidy. Moreover, as we have seen, the rational policymaker would be interested in the present social value of an investment in the education of an individual, not simply in the marginal social benefit of the student after completion of his studies. Since both the social costs of training a student and the social benefits that he could produce if he did not go to college are likely to be higher for the more able than for the less able youth, evaluation of the present social value of education is likely to favor the able youth less than would an evaluation of marginal social benefits.[52]

However, while it may be likely that a national scholarships policy would lead to less emphasis on intellectual ability in allocating college teaching subsidies, this need not be the case. If the national interest appears to call for the training of an intellectual elite, a coordinated subsidy policy would enable policymakers to pursue this goal with the greatest vigor and efficiency. A decentralized, college-oriented subsidy system would permit lower-quality colleges to offer subsidies to those

students whom it can attract, including some who are not among the most able in the country. A coordinated, student-oriented system could permit policymakers to focus their subsidy resources on a national intellectual elite.

An explicit consideration of the quality-quantity decision (number of students to train versus among of resources per student) in the context of a national scholarships policy might also lead to unexpected results. In the United States an emphasis on the social rather than academic gains from education has been traditionally associated with mass education. However, if policymakers in fact believed that there were some important increasing social returns to be produced by increasing the resource-student ratio, a national scholarships policy could lead to a reduction, rather than to an increase, in the college student population.

This quantity-quality decision is closely related to the question of the extent to which the student's own financial resources will determine the investment in his college education -- an emphasis on high-quality education is likely to be associated with an increase in the wealth determination of the allocation of college teaching resources. If the agency chooses high-quality education for the few as its goal, then the logic of our model dictates that (unless there is some offsetting bias in favor of lower-class students, so that a few poor students receive high-quality education) the few students to be educated will be chosen from among those who can make the largest financial contribution of their own: i.e., the wealthier students. Even if the agency's quality preference is not as extreme as this, and it is also willing to give some support to those undertaking lower-quality education, its subsidy may still be greatest for those willing and able to undertake the more expensive college training.

These results have an analogy in the present allocation of resources: today, although competition among the higher-quality colleges keeps tuition well below the level of teaching costs, it is sufficiently high to bar the average high school graduate from these schools. Hence, in the present distribution of subsidy some of the largest amounts go to the wealthier students.[53] Moreover, in both the decentralized and the coordinated subsidy systems, the really poor student may be denied all financial help, even though he is of above average ability.

Thus it would appear that, despite the optimism of some reformers, the rational coordination of subsidies into a national policy might replicate a number of the apparent anomalies of the present system. While one can predict that social values would be likely to take precedence over academic goals, and that goals, of whatever their nature, could be pursued with greater efficiency, coordination need not lead to a more democratic allocation of college teaching resources.

However, if the present economic inequality is not due to the irrationality of the scholarship system, much of it has been seen to be due to an inadequate level of subsidy. It is likely that a national scholarships policy would serve as a powerful impetus to an increase in the present subsidy level and hence to the extension of quality college education to larger groups in the population. A coordinated system would clearly establish a system-wide λ, and thus a cutoff benefit-cost ratio for those without funds. If this cutoff benefit-cost ratio[54] is significantly greater than unity at the present level of subsidy (as one would expect), then there might be a concerted social effort to increase expenditure on college teaching to the level where λ is reduced to zero and the benefit-cost ratio to unity: i.e., to the point where all students for whom the

marginal social benefits of their education exceed the costs will attend college, and will attend a college of at least an optimal quality.

The most important effect of the substitution of a national scholarships policy for the present decentralized system, therefore, might be an expansion of the level of college teaching funds to the point where the social rate of return would be the sole determinant of admissions to college and of college quality. Private benefits and wealth would only determine investment in college for those who wished to spend in excess of the socially optimal amount.

Footnotes

[1]K.A. Simon and W. V. Grant, Digest of Educational Statistics 1966 (Washington, D. C.: Government Printing Office, 1966) Table 73.

[2]Ibid., Tables 106, 112.

[3]Ibid., Table 78.

[4]In 1963-64, federal subsidies to higher education totaled over $2 billion, (ibid., Table 106).

[5]College Board Review, various issues.

[6]See W. J. Bender ("A Critical Role for the Colleges," College Board Review, No. 39 / Fall, 1959 /: 8-11) for a critique by the then Dean of Admissions and Financial Aid, Harvard College, of the existing patchwork quilt of private college subsidies and a plea for greater coordination of student aid programs.

The problem of obtaining agreement on a common scholarship policy is beyond the scope of this paper. However, it would be unfortunate if the possibility of taking into account the system-wide effects of individual policies were rejected because some colleges disagree with the majority. Compensating action on the part of the majority might be used to bring about much greater conformity with national goals than would inaction.

For example, if some colleges refused to give scholarships to members of minority groups, others could give more than their share to them. This action might be complemented by a policy of making federal or foundation support a positive function of the extent to which colleges give aid to such students.

[7]S. Mushkin, editor (Washington: U.S. Department of Health, Education, and Welfare, 1961) p. 214.

[8]See B. A. Weisbrod, External Benefits of Public Education, Princeton University Research Report Series 105, Industrial Relations Section (Princeton, N. J.: Princeton University Press, 1964), for an extended discussion of the various social benefits of college education.

[9]Moor's policy would be rational if each student had a separate ability rating and each policymaker had a lexicographical preference ordering with respect to student ability (so that one student with, say, an I.Q. of 140, would always be worth more to the college system than one hundred students with I.Q.'s of 139).

[10]If the college is abiding by College Scholarship Service rules, it cannot offer a higher scholarship or "price" to the more able student but must set scholarships in accordance with need and ration places on the basis of benefits and "prices."

[11]S. E. Harris, Higher Education: Resources and Finances (New York: McGraw-Hill, 1962), p. 180.

[12]However, they would permit high-quality colleges to add their own funds to the federal scholarship.

[13]See note 6 above.

[14]See H. Daniere, Higher Education in the American Economy (New York: Random House, 1964), and C. Kaysen, "Some General Observations on the Pricing of Higher Education," in S. Harris, ed., Higher Education in the United States: The Economic Problems, suppl. to Review of Economics and Statistics, vol. 42, no. 3 (August, 1960), for a discussion of the difficulties of measuring the cost to the college of educating a student.

[15]Seen Daniere, op.cit., especially chaps. 10-11, for a discussion of these problems.

[16]Since, in this model, the temptation to behave monopsonistically only arises where the budget acts as a constraint, it may be taken as one more argument in favor of an adequate subsidy.

[17]See the discussion below of interdependence.

[18]To pursue this example further, the agency might decide to train the most able but to use large classes, teaching machines, and lower-quality teachers; or it might make other substitutions for able teachers. In any event, these monopsony considerations are likely to be less important in the long run, since one would expect the supply elasticities of teachers and other resources to be higher in the long run.

[19]The agency would have to ascertain whether a college was actually charging a living expense as part of its tuition.

[20]In the short run, though, the maximum investment is fostered by the scholarship program, not the loan program. If the student's financial contribution to his education is positively related to his estimate of the present value of his college education, and if the present value of his college education is reduced by the condition that he must make payments to the agency out of his income (and will be reduced more the larger these repayments are), then the student's contribution will be reduced when some repayment is required. Hence, a given amount of subsidy dollars will spur a greater investment in college in the years in which it is spent if it is disbursed without repayment conditions than if it is given as a loan.

[21]See S. Marglin, "Objectives of Water Resource Development: A General Statement," and "Economic Factors Affecting System Design," in A. Maass et al., eds., Design of Water Resource Systems: New Techniques for Relating Economic Objectives, Engineering Analysis and Governmental Planning (London: MacMillan, 1962) for a solution in a rather similar case. However, a computational solution here will be somewhat more difficult than the case he discusses, since he assumes strictly diminishing returns to investment. We have no reason to rule out the possibility that $Y_{kk} > 0$ for certain ranges of K for many individuals, and thus a solution here must concern itself with the problems of minimal solutions and of local optima.

[22]This simplification ignores annual variations in benefits, the cessation of benefits at retirement or death, and interest on or discounting of benefits and costs in the four-year period after high school graduation. However, it will serve to illustrate the features of social choice that are most relevant to the present discussion.

[23]V_i and S_i are assumed here to be continuous functions over individuals. For a given individual, V_i and S_i will be assumed to be continuous functions of K_i. In a national sample of millions of students, it is unlikely that departures from these continuity assumptions would be important.

[24]Since strictly diminishing returns to K are not assumed here, multiple optima are possible. It will be necessary, then, to make certain that total as well as marginal conditions are met, e.g., to rule out cases such that

$$\frac{Y^*_j - Y'_j}{r(K^*_j - K'_j)} - 4 < \lambda \quad \text{even when} \quad \frac{Y^*_{jK}}{r} - 4 > \lambda.$$

Where Y* is the level of Y set by the agency, Y' is the level of Y chosen by the student in the absence of subsidy, K* is the level of K set by the agency, K' is the level of K chosen in the absence of subsidy, and λ is the value of the marginal subsidy dollar (see the discussion of λ on p. 12 below).

[25]See G. Becker, Human Capital, National Bureau of Economic Research General Series, no. 80 (New York: By the Bureau, 1964), for an informative treatment of the individual's college decision in terms of investment theory.

[26]Financial benefits are the increase in money income the student expects if he graduates from college. Nonfinancial benefits are the higher consumption or utility that a college graduate hopes to gain from his enhanced knowledge of how to exploit his leisure time more intelligently and to consume goods and services more efficiently, the more pleasant working conditions that a college graduate may expect to enjoy, and any preference the youth may have for studying for four years rather than working.

[27]The costs of college here include tuition and the value of foregone earnings. In practice, the tuition measure might be expanded to include books, fees, the expense of maintaining two households, and other direct costs of sending a son or daughter to college. On the other hand, opportunity costs would be reduced by student earnings from part-time employment.

[28]See note 22 for the simplifications used in this model. Benefits and costs are expressed in certainty-equivalents, as are the benefits and costs in the model of social choice. In these models, then, differences between the attitudes of the agency and the student toward the uncertainty of the student's future benefits would appear as a difference between social and private benefits. If repayments are permitted, differences in attitudes towards uncertainty can be used to increase the benefits from the subsidy program. See M. Friedman, Capitalism and Freedom (Chicago: University of Chicago Press, 1962); K. Shell, F. Fisher, D. Foley and A. Friedlander, "The Educational Opportunity Bank," National Tax Journal, XXI (March, 1968): 1-45; W. Vickery, "A Proposal for Student Loans," in S. Mushkin, ed., The Economics of Higher Education (Washington, D.C.: Department of Health, Education, and Welfare, 1961); and Educational Opportunity Bank: A Report of the Panel of Educational Innovation to U.S. Commissioner of Education Harold Howe II, Director of the National Science Foundation, Leland J. Haworthy and Special Assistant to the President for Science and Technology, Donald F. Hornig (Washington, D.C.: U.S. Government Printing Office, August, 1967), for ingenious proposals of this type.

[29]A student may also have $\hat{V}_i > 0$, $V_i < 0$. By constraint number one, the agency ignores these "overinvestors" altogether.

[30]Actually, S_i must equal $-\hat{V}_i$ plus some small, positive amount to ensure that the high school graduate will have some preference for going to college.

[31]In practice, the student's marginal rate of time preference may exceed his average rate, so that he will use a higher discount factor in considering an addition to his investment in college education than he will in deciding whether to go to college at all.

[32]If this constraint were relaxed, i.e., if the agency could simply tell the student what level of tuition he will have to pay if he wishes to go to college, the requisite subsidy for the underinvestor could be made equal to $-\hat{V}^*_i$ where $\hat{V}^*_i < 0$, and equal to or less than zero where $V^*_i \geq 0$. Thus the free choice offered the student by this constraint raises the student subsidy by $\hat{V}'_i$ where $\hat{V}^*_i < 0$, and by at least $\hat{V}'_i - \hat{V}^*_i$ where $\hat{V}^*_i \geq 0$.

[33]In practice, some decentralization in preference-making might be incorporated so that more than one view can be expressed on a student's merit.

The agency must also be able to measure its social time preference. This level of time preference, r, can be crucially important in ranking students. If two students receive equal rank (R), and one has a high

social internal rate of return on his potential education but is unable to pay for a large proportion of his education, while the other is wealthier but has a low social internal rate of return, an increase in social rate of time preference, r, will lead the poor student to be preferred to the wealthy, and a decrease will give the wealthy student a relatively higher R, and thus lead to his being preferred. Let student i have an internal social rate of return of 10 per cent and be willing to pay two-thirds of his education. Let the rate of return be 15 per cent for j, who will only pay one-third of his education. At r = 5 per cent the two students will be ranked as equals by the agency. At r greater than 5 per cent the agency will prefer the poor student j; at r less than r per cent it will prefer the wealthy student i.

[34]See M. V. Pauly, "Mixed Public and Private Financing of Education," American Economic Review, 57 (March, 1961): 120-30, and W. C. Stubblebine, "Institutional Elements in the Financing of Education," Southern Economic Journal, 32 (July, 1965): 15-35, for an analysis of these problems in financing public education. See also J. M. Buchana and G. Tullock, "Public and Private Interaction Under Reciprocal Externality," in J. Margolis, ed., The Public Economy of Urban Communities (Baltimore: Johns Hopkins, 1965), and O. A. Davis and O. B. Whinston, "Externalities, Welfare, and the Theory of Games," Journal of Political Economy, 70 (June, 1962): 241-62, for further discussion.

[35]Several small subgroups within a particular group could be offered subsidies of varying sizes. The group scholarship would then be set at that level which would be just adequate to induce most of its typical members to go to college. Underinvestors in the test groups might be offered a choice between going to a college of the agency's choice plus a subsidy. By setting the subsidy at different levels for each test subgroup, the agency could determine the amount that would just suffice to induce the average member of the group to choose a college quality of the agency's choice.

[36]Obviously, it does not know which members will respond to the higher subsidies. If it did, it would refine its price discrimination to offer different subsidy levels to different individuals within the group.

[37]This result is obtained by maximizing NV_i, subject to the constraint that $d(NV_i)/d(NS_i) = \lambda$. This decision-rule would not be optimal if, within the group, the social value of a student's education was positively correlated with the private value and hence negatively correlated with the subsidy required to induce him to go to college. If the agency's errors in estimating the private and social value of college for individuals within the subgroup are positively associated, as the proportion of students in the group induced to go to college approaches unity, the use of some average level of the social value of the education of students within the group will tend to yield an overestimate of the social value of educating the marginal student. If the social value of the marginal student could be estimated, the correct decision-rule would then be to set $S_i = \frac{V_N}{\lambda(1 + E_{si,N})}$, where V_N is the social value of the college education of the student who is induced to go to college by a marginal increase in subsidy.

[38]This rule may be construed as violating the anti-monopsony constraint, in that the agency no longer restricts its estimate of a student's cost to the money paid to him. However, it does not take into account changes in supply price of resources or in the opportunity costs of students that results from an individual subsidy. Hence, it still substantially conforms to the anti-monopsony rule.

[39]Other things being equal. Actually, if the cases where $R_i > \lambda (1+E_{S_i,N})$ predominated, λ itself would increase because of the subsidy budget constraint. If the elasticities were sufficiently high, λ would decrease.

[40]This interdependence will not be as close, however, as that observed by O. Eckstein, Water Resource Development (Cambridge, Mass.: Harvard University Press, 1958), Marglin, op.cit., and others in the cost-benefit analysis of dambuilding, in which the building of dam A may be required to make feasible the building of dam B, but will make the building of dam C unnecessary. The college educations of Mr. Jones, Mr. Smith, and Mr. Brown are not likely to have that relationship.

[41]Interdependencies will also exist among succeeding "generations" of college students. The social benefits and costs of a college education might best be estimated in the context of a national plan in which this year's crop of college graduates is determined along with a plan, or at least a forecast, for the next fifty years' supply of college graduates. If possible, this long-term plan for higher education should be made simultaneously with a long-term plan for national economic growth (see I. Adelman and E. Thorbecke, eds., Theory and Design of Economic Development (Baltimore: Johns Hopkins, 1966), S. Bowles, "The Efficient Allocation of Resources in Education," Quarterly Journal of Economics, 81 (May, 1967): 189-219, and I. Adelman, M. Geier, and F. Golladay, "Education and Economic Development," paper presented to the American Economic Association, Washington, D. C., December, 1967, for ambitious examples of long-term educational planning of this type). However, for each set of estimates of the social benefits of college education that is derived from such a national plan, it will still be necessary to find a method of allocating scarce subsidy funds among needy college students.

[42]By "high-quality" is meant most resources used per student. If college quality is measured simply in terms of the ability of the student-body, and if students are segregated by ability in colleges, then the most able student will always go to the highest-quality college.

[43]S. Hunt, "Income Determinants of College Graduates and the Return to Educational Investment," (Ph.D. diss., Yale University, 1963), finds that the private rate of return on increments to resources per student, as measured by tuition, has a strong positive relationship to student ability. Data presented in D. Wolfle and J. Smith, "The Occupational Value of Education for Superior High School Graduates," Journal of Higher Education (April, 1956), 201-213, of earnings of high school and college graduates at different ability levels strongly suggest a positive relationship between ability and the private rate of return on college education.

[44]See J. W. Trent, "A New Look at Recruitment Policies," College Board Review, no. 58 (Winter, 1965-66): 7-11, and R. J. Havighurst, American Higher Education in the 1960's (Columbus, Ohio: Ohio State University Press, 1960), pp.32-33, for the tendency of the more able to go to college. A. L. Sorkin, "Some Factors Associated with Tuition in Public and Private Colleges and Universities," mimeographed (Washington, D.C.: Brookings Institution, 1968), found that the able tended to go to colleges that charged higher tuition (both within the private and the publicly controlled groups). He also found that college tuition was positively associated with a vector of college quality variables.

[45]S. E. Harris, Higher Education: Resources and Finances (New York: McGraw-Hill, 1962), pp. 229-32.

[46]Wolfle and Smith, op.cit., Table VIII, present data that suggest that the financial rate of return to college is in fact higher for the able middle-class youth than for the able working-class youth. See P. H. Rossi and Z. D. Blum, "Social Stratifiction and Poverty," Paper presented at the Sociological Research Association Annual Meeting, San Francisco, August 12, 1967, pp. 66-71, for a summary of the evidence of a positive correlation in the population between intellectual ability and economic class.

[47]Thus one would expect the financial rate of return to college to be lower for the son of a carpenter or electrician, whose access to a closed-shop union is independent of a college education, than for the son of a doctor or businessman, whose contacts and information may best be exploited with a college degree.

[48]Members of the College Scholarship Association must set scholarship levels on the basis of financial need. However, a college administration operating with a limited budget will find that it can improve the college's academic quality by requiring higher admissions standards from those applicants whose financial needs are greater (see p. 5 above) than from other applicants. Hence, in an important sense, intellectual ability, as well as financial need, may determine the size of the scholarship offered by the college.

[49]This is important in reducing the determination of the allocation of college teaching resources by wealth or class if (a) the tuition reduction is greater at the low-cost than at the high-cost college or (b) the price elasticity of demand for college education is inversely related to income.

[50]Some, but not all, of these private benefits could also be included in the national policymaker's objective function. The individual's psychic income might be treated as a social benefit, along with a portion of his gain from contacts and information. However, it is unlikely that gains from closed-shop unionism, nepotism, or other forms of personal influence would be included.

[51]In general, though, the proportion of costs paid by a given student will probably decline as the agency subsidy becomes larger.

[52]In our simplified model of social choice, I_i will increase with Y_i if $dY/dX > 1+4I$.

[53]See W. J. Bender, "A Blunt Warning," College Board Review, no. 45 (Fall, 1961): 24-28.

[54]The cutoff benefit-cost ratio for those without funds in this model equals $1+ \lambda(1+F)$.

List of Symbols

$\hat{V}_i$ = Present value of a college education of the ith individual (to the ith individual)

$\hat{r}_i$ = Time preference of the ith individual

r = Social rate of time preference

Y_i = Social benefit of the ith person if he goes to college (annual)

X_i = Social benefit of the ith person if he does not go to college (annual)

K_i = Resource cost of the ith person's college education (annual)

V_i = Present social value of the ith person's college education

I_i = Internal social return of the ith person's college education

C_i = Contribution to college education expenses of the ith person

S_i = Subsidy required for college education of the ith person

m = The marginal student

R_i = Ranking function of the ith student

W = Private minus social costs (annual) of college of the ith person

Z_i = Private minus social benefits (annual) of college of the ith person

$$F_i = \frac{4W_i}{4(X_i+K_i)}$$

$$A_i = \frac{Z_i}{4(X_i+K_i)}$$

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TITLE

An Economic Analysis of College Scholarship Policy

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INSTITUTION (SOURCE) **Center for the Study of Social Organization of Schools, Johns Hopkins University, Baltimore, Maryland 21218** — SOURCE CODE

REPORT/SERIES NO. **Report No. 24**

OTHER SOURCE — SOURCE CODE

OTHER REPORT NO. **BR 6-1610-12-03**

OTHER SOURCE — SOURCE CODE

OTHER REPORT NO.

PUB'L. DATE **August -1968** — CONTRACT/GRANT NUMBER **OEG-2-7-061610-0207**

PAGINATION, ETC.

39

RETRIEVAL TERMS

College Scholarship
Tuition Subsidies
Allocation of Educational Resources
Economics of Higher Education

IDENTIFIERS

ABSTRACT

This paper applies the techniques of cost-benefit analysis to the problem of allocating subsidy funds to college students. The study shows the desirability of using such economic principles as comparative advantage, discounting of future benefits, and a cut off benefit-cost ratio in the allocation of these funds. An attempt is made to show the superiority of these methods over a system of selecting students solely in terms of their intellectual ability.

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